MONTHLY WEATHER REVIEW,

APRIL, 1880.

(General Weather Service of the United States.)

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In preparing this REVIEW the following data, received up to May 13th, have been used, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 139 Signal Service stations and 14 Canadian stations, as telegraphed to this office; 138 monthly journals and 159 monthly means from the former, and 14 monthly means from the latter; reports from 27 Sunset stations; 225 monthly registers from Voluntary Observers; 39 monthly registers from United States Army Post Surgeons; Marine Records; International Simultaneous Observations; monthly reports from Voluntary Observers in, and the local Weather Service of, Missouri; reliable newspaper extracts; special reports.

BAROMETRIC PRESSURE.

Barometric Pressure.—As compared with the means for the preceding eight years, the pressure for April, 1880, east of the Rocky Mountains, shows a marked deficiency in Iowa, Minnesota and the Upper Lake region, with a corresponding excess over the Middle Atlantic, South Atlantic and East Gulf States, Tennessee and along the coast of New England. The greatest excess is reported from Augusta, Georgia, 0.12 inch above the mean, and the most marked deficiency prevailed at St. Paul, Minn., .08 below the mean. On the Pacific coast region, as compared with the preceding three years, a marked deficiency, ranging from .02 to .09, is reported from Oregon and Washington Territory, while in California an excess prevailed, ranging from .02 at Red Bluff to 0.11 at San Diego.

Local Barometric Ranges.—East of the Rocky Mountains the barometric ranges for April, 1880, increase gradually from the Florida Peninsula northwestward to the States of Nebraska, Iowa, Minnesota. Ranges exceeding one inch occurred in the Upper Lake region, the Upper Mississippi and Lower Missouri valleys, and the eastern Rocky Mountain Slope from central Texas northward to Dakota. The minimum ranges were 0.35 inch at Key West, 0.40 at Punta Rassa, and the maximum ranges 1.54 at North Platte and Marquette, 1.65 at Omaha and 1.89 at Duluth. On the Pacific coast the ranges regularly increased northward; maximum range 1.20 at Umatilla.

Areas of High Pressure.—Eleven areas of high pressure have appeared during *April* within the limits of the Signal Service maps. Three areas only are of interest:—No. II which, in connection with low area No. II, produced the very heavy rains, from the 2nd to the 4th, on the Pacific coast; No. IV which was marked by the severe frost in the Southern States from the 9th to 12th; No. VIII which, developing on the Pacific coast, passed eastward to the Atlantic coast and was marked by the unusually cold weather from April 29th to May 1st.

No. I.—This area, covering the Ohio valley and the Atlantic States during the 1st, withdrew slowly northeastward and dissipated during the 4th in the Canadian maritime provinces. The highest pressure was reported from Halifax the morning of the 3rd; barometer 30.47, or 0.70 above the normal. During the 2nd, brisk winds being reported, Cautionary Signals were ordered from Fort Macon northward to Sandy Hook.

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These signals were fully justified in connection with this area and were continued, in connection with low area No. I, until the 5th; maximum velocities: SW. 36 at Kittyhawk, Capes Lookout and Hatteras; S. 46 at Delaware Breakwater.

No. II.—During the 3rd the pressure rose rapidly on the Pacific coast; midnight barometer at Los Angeles, 0.24 above the normal. The centre of high pressure gradually moved northward, and on the afternoon of the 5th the highest pressure was reported from Umatilla, 0.47 above the normal. The highest pressure remained substantially unchanged over Oregon until the 7th, when it withdrew eastward over the Northern Plateau district and gradually dissipated on the 9th, in advance of low area No. V. In connection with this area and low area No. II, exceedingly heavy storms of rain on the coast and snow in the interior, continued from the morning of the 1st until midnight of the 4th. During the 1st and 2nd the rains were specially heavy, more than two inches, within twenty-four hours, being reported from many places in California.

No. III.—During the night of the 5th the pressure rose rapidly in the entire Missouri valley. By the afternoon of the 6th Bismarck barometer was 0.54 above the normal. Moving slowly southeastward, the highest pressure, the afternoon of the 7th, was at Leavenworth, and on the morning of the 8th at Fort Sill, where the barometer was 0.56 above the normal. At that time the entire country, except Sydney, C. B., was covered by a pressure above the normal. The afternoon of the 8th the highest pressure of the area was reported from Eagle Pass, 0.63 above the normal. The highest pressure remained unchanged in southern Texas until the 11th, when it gradually dissipated. The signals in the Lake region, in connection with this area, are treated of in the description of low area No. I. The Cautionary Off-shore Signals, displayed on the Texas coast, from midnight of the 6th until the afternoon of the 8th, were fully justified by northerly winds of 36 miles at Galveston, and 49 at Indianola. A north wind of 26 miles is also reported from the Eastern Gulf, at Cedar Keys, on the 8th.

No. IV.—As low pressure No. IV moved eastward it was followed by this area. Central in the Upper Missouri valley on the morning of the 10th, it moved slowly southeastward to the Ohio valley, where the highest pressure of the area was reported from Cairo, on the morning of the 12th, 0.48 above the normal. Moving thence nearly eastward it withdrew slowly, during the 14th, from the Carolina coast over the Atlantic ocean. On the morning of the 11th, the isotherm of 32° minimum temperatures passed to the south, ward of the Lake region, the Ohio and the greater part of the Upper Mississippi and Lower Missouri valleys. and on the morning of the 12th passed to the southward of east Tennessee and the interior of North Carolina. Serious and numerous frosts were reported from the 9th to the 12th, as far south as parallel 33°. The minimum temperatures of the month were reported in connection with this area. The signals in the Upper Lake region, during the 10th, are treated in connection with low area No. IV. During that date Cautionary Off-shore Signals were ordered from Smithville to Cape Lookout and the signals from Eastport to Cape Hatteras were changed to Off-shore. These signals were lowered on the New England coast during the 11th, and on the New Jersey and North Carolina coasts during the 12th, having been fully justified; maximum velocities: Portland, NW. 26; Sandy Hook, NW. 40; Cape Henry, NW. 43; Delaware Breakwater, NW. 44.

No. V.—During the 15th an area of slight importance appeared over the province of Ontario and by the morning of the 17th had withdrawn northeastward over the Gulf of St. Lawrence. In the afternoon of the 15th Cautionary Off-shore Signals were ordered from Sandy Hook southward to Chincoteague. These signals were partly justified by velocities of SW. 28 at Delaware Breakwater and SW. 32 at Chincoteague.

No. VI.—During the 18th and 19th an area covered the greater part of California, but dissipated on the latter date in advance of low area No. XII.

No. VII.—This area developing in the Ohio valley during the night of the 16th had moved northeastward to the Lower St. Lawrence by the afternoon of the 18th. Extending from Connecticut northeastward to Nova Scotia it remained substantially unchanged until the 22nd when it withdrew eastward over the Atlantic Ocean. On the morning of the 17th the Cautionary Signals displayed in connection with low area No. VIII were changed along the Atlantic coast to Off-shore, and were lowered that afternoon, having been fully justified; maximum velocities: NW. 36 at Sandy Hook and Chincoteague; NW. 38 at Delaware Breakwater.

No. VIII.—This area appeared in northern Texas the morning of the 19th and moving eastward to the Middle Atlantic coast united with area No. VII. on the 20th and withdrew eastward over the Atlantic Ocean on the 22nd. Cautionary Off-shore Signals were ordered on the morning of the 19th for the Western Gulf and were lowered at midnight, having been justified by velocities of N. 27 at Galveston and N. 41 at Indianola. On the Atlantic coast, brisk winds having been reported, Off-shore Signals were ordered at noon of the 20th from Sandy Hook southward to Kittyhawk, and were lowered later in the day, having been but partly justified; maximum velocity: N. 32 at Delaware Breakwater.

No. IX.—The pressure increasing on the Pacific coast during the 22nd, the barometer at Olympia the afternoon of the 23rd was 0.34 above the normal. The pressure remained unchanged until the 27th, when it withdrew eastward over the Northern Plateau district, where, on the afternoon of the 28th, the Virginia City barometer was 0.32 above the normal. On the morning of the 29th the highest pressure was at Deadwood, 0.35 above the normal. Its course thence was southward to Texas, where the highest pressure of the

area prevailed during the 30th, Fort Sill barometer that afternoon 0.60 above the normal. At midnight of the 30th the area was gradually moving east, with diminishing pressure. The passage of this area was marked by unusually low temperatures for the season. On the morning of the 30th the isotherm of 32° minimum temperatures passed to the southward of the greater part of the Upper Lake region, the Missouri valley and the Rocky Mountain slope as far south as northwestern Texas; at midnight freezing temperatures were reported from the Lower Lake region and from the interior of New York and New England. On the morning of the 29th Cautionary Off-shore Signals were displayed on the Texas coast and were lowered that afternoon, justified as to velocity, but not as to direction. During the 30th the Cautionary Signals from Cape Hatteras to Eastport were changed to Off-shore. These signals were lowered on the 1st of May, having been justified, except on portions of the Maine and North Carolina coasts: maximum velocities: N. 28 at Cape Lookout; NW. 44 at Sandy Hook and Cape Henry; W. 32 at Boston.

No. X.—On the 22nd this area appeared over the Upper Lake region. On the morning of the 23rd the highest pressure was reported from Rockliffe—0.42 above the normal. This area remained over the Canadian Maritime provinces from the 24th to the 25th on which date it gradually dissipated. On the 22nd Cautionary Signals were ordered for Lakes Erie and Ontario in the morning, and for the Upper Lake region in connection with advancing low area No. XIII, at midnight. The signals for the entire Lake region—generally justified—were continued until the 25th, and are discussed in the low area above mentioned. In the morning of the 23rd Cautionary Signals were displayed from Eastport to Chincoteague, and during the afternoon southward to Fort Macon. These signals were lowered that afternoon in New England, (not justified,) but were continued on the Middle Atlantic and Carolina coast until the 25th, and were fully justified; maximum velocities: Delaware Breakwater, NE. 36; Kittyhawk, S. 36; Sandy Hook, E. 42.

No. XI.—This area appeared in Indian Territory the morning of the 26th, and moving northeastward prevailed in the Ohio valley during the 27th. Central on the Middle Atlantic coast during the 28th, it extended northward during the night and on the morning of the 29th the highest pressure of the area prevailed at Halifax—barometer 0.67 above the normal. During the 30th it withdrew eastward or dissipated in advance of low area No. XV. On the morning of the 27th Cautionary Off-shore Signals were ordered for the Texas coast and were lowered that afternoon, not justified. At midnight of the 26th Off-shore Signals were ordered from Cape Hatteras to Wood's Holl and on the following morning thence northward to Portland.. These signals were lowered during the 27th, having been fully justified; maximum velocities: Portland, NW. 26; Cape Hatteras, NW. 29; Sandy Hook and Delaware Breakwater, NW. 34.

Areas of Low Pressure.—During the month of *April*, 1880, fourteen areas have been charted on the Signal Service Weather Maps. Six of these first appeared on the Pacific coast north of California; four developed on the Eastern Slope of the Rocky mountains; three came from Manitoba or Saskatchewan, and one developed in the Lower Mississippi valley. The areas of most marked interest are Nos. X and XIII. During the passage of No. X occurred the violent storms of the 18th, in Arkansas, Missouri, Iowa and Illinois. In connection with area No. XIII occurred the violent rain and snow-storms on the Pacific coast during the 20th and 21st, and the severe local storms of the 24th in Missouri and Illinois.

No. I.—This area, central in northwestern Wyoming the morning of the 2nd, moving southeastward, reached western Kansas at midnight. Moving very slowly eastward, with still decreasing pressure, at midnight of the 2nd, it was in northern Missouri. During the 2nd, in the Western Gulf States high temperatures and cloudy weather, with heavy rains, prevailed with brisk to high southerly winds on the Texas coast; maximum velocity, SW. 43 miles at Indianola. In the Upper Missouri and Mississippi valleys, cold northerly winds, with heavy rains, were reported. Destructive local storms, causing loss of life and property, occurred at Ottawa and Girard, Kan., and at Shreveport, La., which are elsewhere mentioned. Changing its course to the northeastward, the storm was central during the 3rd in the region of Lake Michigan. During the 4th it passed slowly northeastward over the Lower Lake region, down the St. Lawrence valley, and by midnight of the 5th it reached the Gulf of St. Lawrence. At midnight of the 2nd a Cautionary Off-shore Signal was ordered at Indianola, and Cautionary Signals for the entire Lake region. The signal at Indianola was lowered the morning of the 4th, justified as to velocity, but not as to direction. The signals in the Lake region were lowered on the morning of the 5th, having been justified on the 4th, in connection with high area No. III., at scattering stations in the Lower Lake region, but at Duluth only in the Upper; maximum velocities: at Duluth, NW. 30; Sandusky, W. 34. The signals displayed in connection with high area No. I., from Fort Macon to Sandy Hook, were continued from the 3rd to the morning of the 5th, when they were lowered, having been fully justified; maximum velocities: Chincoteague, SE. 44; Capes Hatteras and Lookout and Kittyhawk, SW. 36.

No. II.—The approach of this area was marked on the Middle Pacific coast by heavy rains on the 1st, which became general in California by the morning of the 1st, and extended to the Northern Pacific region during that day. The area, on the afternoon of the 2nd, was central, with unusually low pressure, in southern Oregon. The area dividing, one portion moved northeastward, and passed into British Columbia by the morning of the 3rd. In connection with this area and high area No. II., which moved northward along the Pacific coast, unusually heavy rains fell all along the entire Pacific coast from the 1st to the 3rd, over two inches having been reported in that time from many stations. The second portion, moving nearly eastward, passed through Montana and Dakota into Manitoba during the 3rd.

No. III.—This area moved northeastward over the Atlantic Ocean during the 7th, at some distance from and nearly parallel with the coasts of New England and Nova Scotia. This area was possibly a

southern offshoot of No. I. No signals were displayed in connection with this area. Velocities of 27 miles NW. at Eastport and 28 NW. at Boston were reported.

No. IV.—This area was apparently central north of Lake Superior at midnight of the 8th. Moving slowly southeastward, on the morning of the 10th it was central, with greatly decreased pressure, over Lake Huron; Port Huron barometer 0.55 below the normal. Moving thence northeastward over the Lower Lakes and through St. Lawrence valley, it reached the St. Lawrence valley during the 11th, on which day the lowest pressure of the area was reported from Eastport in the afternoon—29.15, or 0.70 below the normal. On the morning of the 9th signals were ordered for the entire Lake region, except Duluth and Lake Ontario. During the afternoon they were ordered for Lake Ontario and the Atlantic coast, from Eastport southward to Chincoteague. These signals were lowered in the Lake region on the morning of the 11th, having been fully justified by unusually high winds during the 9th and 10th; maximum velocities: N. 40 at Escanaba and Grand Haven; NW. 48 at Sandusky; SW. 37 at Buffalo. In connection with advancing high area No. IV the signals in the Upper Lake region were continued during the 10th, and along the Atlantic coast on that date they were changed to Off-shore from Cape Hatteras northward to Eastport. The Cautionary Signals on the Atlantic coast were fully justified; maximum velocities: S. 34 at Boston and S. 40 at Delaware Breakwater.

No. V.—This area appeared on the Northern Pacific coast during the 9th, and, moving northeastward through Washington Territory, passed into British Columbia by the morning of the 10th. Its passage was marked by moderate rains in the Central and Northern Pacific coast regions.

No. VI.—This area—possibly identical with area No. V—was central in Manitoba on the morning of the 12th. Moving southeastward, at midnight it was central in western Minnesota. It remained nearly stationary until midnight of the 13th, when it united with area No. VII in the Lower Missouri valley. On the afternoon of the 12th brisk winds being reported from Lake Michigan and the Lower Lake region Cautionary Signals were ordered for the entire Lake region. These signals—fully justified—are discussed in connection with low area No. VII.

No. VII.—At midnight of the 11th a sharp fall of pressure was reported from the Oregon coast. The area moving southeastward was central the morning of the 13th in Utah; Salt Lake barometer 0.42 below the normal. Moving rapidly eastward, at midnight it united with low area No. VI. in the Lower Missouri valley; North Platte barometer 0.64, Yankton 0.65 below the normal. At that time a cloudless sky within a radius of two hundred and fifty miles from the centre of the depression was reported, and at no point within five hundred miles had precipitation occurred within the preceeding forty-eight hours. Changing its course to the northeast with decreasing pressure, the area was central in the afternoon of the 14th in northwestern Wisconsin; Duluth barometer 29.16 or 0.77 below the normal. Central at midnight of the 14th over the eastern end of Lake Superior, it moved rapidly eastward with increasing pressure and by midnight of the 15th had reached the Gulf of St. Lawrence. The signals displayed in the Lake region for low area No. VI. on the 12th, and continued for this storm, were lowered during the morning and afternoon of the 15th. During the 13th and 14th, brisk to high southerly to westerly winds prevailed in the entire Lake region, fully justifying all signals displayed; maximum velocities: Buffalo, SW. 33; Escanaba, S. 36; Duluth, NE. 38, and Milwaukee, S. 46. Signals for the Texas coast ordered on the 13th, and lowered on the 14th, were justified at Indianola, S. 30; but not at Galveston. On the 13th Cautionary Signals were ordered along the Atlantic coast from Fort Macon northward to Thatcher's Island. The signals north of New York were lowered at midnight of that date, and southward to include Kittyhawk, during the 14th, the signals from Fort Macon to Cape Hatteras remaining displayed until midnight of the 16th, in connection with low area No. VIII. These signals were all fully justified: maximum velocities: Boston and Kittyhawk, SW. 32; Newport, SW. 40; Sandy Hook, SW. 44; Wood's Holl, SW. 53.

No. VIII.—At midnight of the 14th a sharp barometric fall was reported from western Texas, and in the afternoon of the 15th, an area was evidently central in Indian Territory; Dodge City barometer 0.24 below the normal. Moving eastward with rapidly decreasing pressure its centre at midnight was in southern Missouri. During the past 8 hours the barometer had fallen sharply in the central Mississippi valley, where high temperatures, brisk southerly winds and thunder-storms, with heavy rains, prevailed; while from the Lower Missouri valley, cold northerly winds, with rain, were reported. During the evening a severe local storm, seriously damaging property, swept over Natchez, Miss., and its immediate vicinity. On the morning of the 16th the area was central, with diminished pressure, in Illinois; in the afternoon over the western end of Lake Erie, and at midnight in Ontario. At 11 p. m. of the 16th, an abnormal barometric rise of 0.30 in the past eight hours, was reported from the entire Ohio valley, with a marked fall of temperature in the southern half. During that time violent wind-storms occurred throughout the eastern half of Ohio and the western parts of Pennsylvania, and West Virginia; the details of which are given under the heading of *Local Storms*. Central the morning of the 17th in the Province of Quebec, it passed southeastward through New England during the day over the Atlantic Ocean. At midnight of the 15th signals were ordered, except at Duluth, for the entire Upper Lake region, and for Lake Erie, followed on the following morning by signals for Lake Ontario. These signals were lowered on the Upper Lakes at midnight of the 16th and on the Lower Lakes during the 17th. These signals were justified in connection with high area No. VII by gales of unusual severity, accompanied by rain or snow; maximum velocities: Alpena NE. 32; Buffalo, SW. 33; Milwaukee, NE. 36, and Cleveland, W. 50. During the 16th signals were displayed on the Atlantic coast at Eastport, where brisk winds had been reported, and from Sandy Hook south-

ward to Kittyhawk. The signals on the North Carolina coast were lowered at midnight, and those on the New Jersey coast, on the following day. These signals were fully justified; maximum velocities: Sandy Hook, E. 31; Chincoteague, S. 41; Eastport, E. 48.

No. IX.—The pressure fell sharply on the North Pacific coast during the night of the 14th and on the morning of the 15th an area was central on the coast of Washington Territory; Olympia barometer 29.39 or 0.71 below the normal. Moving easterly on the morning of the 16th the area was central in western Montana; Virginia City barometer 0.50 below the normal, and by midnight had passed northeastward into Manitoba. In connection with the passage of this storm, exceedingly heavy rains occurred from the 14th to the 16th on the north half of the Pacific coast, and unusually heavy snow-storms prevailed on the Sierra Nevada mountains. From the 14th to the 16th 4.00 inches of rain-fall at Mendocino, Cal., and during the 15th, 2 feet of snow fell at Truckee and Summit, and 4 feet at Cisco. Several snow slides occurred and travel on the Central Pacific R. R. was seriously interfered with for several days.

No. X.—As area No. IX passed northeastward on the night of the 16th into Manitoba, a considerable fall was reported in the southern segment of that area from Kansas and Nebraska, which continued until morning of the 18th, at which time the area was central in southern Nebraska; Omaha barometer 0.66 below the normal. Moving slowly northeastward, at 3 p. m. of the 18th the area was central in the Missouri valley northwest of Omaha, from which station a S. wind of 42 miles was reported, with the unusually low pressure of 28.85 or 0.90 below the normal and a temperature of 82°. From Bismarck, Dak., and North Platte, Neb., high north winds of 40 and 48 miles, with temperatures below the freezing point, were reported. The report for that afternoon from Yankton has not yet been received. During the preceding eight hours, an abnormal barometric fall, ranging from 0.20 to 0.30, had occurred over the greater part of the States of Iowa and Missouri, and over the eastern parts of Kansas and Nebraska. In the succeeding eight hours an abnormal barometric rise, ranging from 0.30 to 0.34, occurred in the Lower Missouri valley, with an average abnormal barometric fall of 0.16 in the Upper Missouri valley. From 3 p. m. to 11 p. m. of that date the temperature fell 52° at Omaha and 35° at Leavenworth, while in the Upper Mississippi valley the temperature remained stationary at La Crosse; rose 1° at St. Paul, and fell but 1° at Davenport. At 11 p. m. the area was central in the Upper Mississippi valley; St. Paul barometer 28.89 or 0.97 below the normal. Thunder-storms, with high temperatures and brisk southerly winds, then prevailed in the Upper Mississippi valley, while cold north to west winds, ranging from fresh to high, were reported from the Missouri valley. During the evening of that day occurred violent tornadoes in Arkansas, Missouri, Iowa and Illinois. These violent storms by which nearly one hundred persons were killed, and several hundred wounded, and during the passage of which immense damage was done to property throughout these States are as fully described, as is possible at this date, under the head of *Local Storms*. The area, central the morning of the 19th over the western end of Lake Superior—Duluth barometer 28.77 or 1.07 below the normal—passed northeastward during the day into British Columbia. Its course over the Lake region was marked by unusually high winds in the Lake region, where the signals displayed during the 18th, and lowered on the 19th, were fully justified; maximum velocities: Escanaba, S. 33; Toledo and Grand Haven, SW. 40; Alpena and Port Huron, SW. 44; Milwaukee, SW. 48; and Sandusky, NW. 52. Cautionary Signals were displayed during the 18th and 19th from Wood's Holl southward to Fort Macon, and were generally lowered the morning of the 20th. These signals were generally justified: maximum velocities: Barnegat, NE. 28; Wood's Holl, S. 38; Delaware Breakwater, S. 43.

No. XI.—This area, of but slight energy and minor importance, developed during the 19th in Mississippi. Its course was generally easterly and it passed off the Carolina coast during the night of the 20th. No signals were displayed during its passage.

No. XII.—This area, appearing in Dakota on the morning of the 21st, moved eastward during the day through Minnesota and the Upper Lake region, and during the 22nd passed northeastward over Canada to the north of St. Lawrence valley. No signals were ordered for the Lake region in connection with this area. Brisk winds were reported from the Upper Lake region during the 21st, with a maximum velocity of 36 miles SW. at Milwaukee. On the morning of the 22nd, Cautionary Signals were displayed on the New Jersey and Virginia coasts, which were lowered the next morning, having been fully justified; maximum velocities: SW. 27 miles at Chincoteague, and SE. 38 at Delaware Breakwater.

No. XIII.—This area appeared on the Northern Pacific coast during the night of the 19th, and moving eastward through Oregon and Idaho was central in western Montana on the morning of the 22nd. Its passage through the Pacific Coast region was marked by exceedingly heavy rains during the 20th and 21st in the northern half of California; rainfalls, ranging during that time from 3.00 inches to 9.73, being reported. The valleys in the central and northern portions of the State suffered severely from inundations, which damaged crops, washed out railways, carried away bridges, etc. Heavy and violent snowstorms generally prevailed in the Sierra Nevadas, which caused frequent snow-slides and interrupted travel for several days on the C. P. R. R. Pursuing a southeasterly course from Montana, it was central the afternoon of the 23rd in eastern Nebraska; Omaha barometer 29.10, or 0.65 below the normal. The storm remained central with gradually increasing pressure in the valley of the Lower Missouri until midnight of the 24th, when it was in central Missouri. During the 23rd remarkable differences of temperature prevailed between the northwestern and southeastern sides of the area, the difference amounting in some cases to over 30° in a distance of 200 miles. These remarkable differences of temperature continued until the morning of the 25th. About 7 p. m. of the 23rd a severe cyclone occurred in Adams county, Illinois, doing much damage in Lor

raine, Lima and Keene, and injuring many persons. At 5 p. m. of the 24th a severe tornado occurred in Jasper county, Missouri, and at 7 p. m. in Christian county, Illinois, killing and injuring persons and doing great damage to property. Violent thunder-storms also occurred at various other points in Illinois and Missouri. Details are to be found under the head of *Local Storms*. The area moving due northward during the night was central the morning of the 25th in Iowa and that afternoon in Wisconsin. Changing its course to the northeast it passed over the Upper Lake region during that night, and on the 26th moved down the valley of the St. Lawrence. The signals displayed in the Lake region on the 22nd for high area No. X, were continued for this storm until the afternoon of the 25th, and were then lowered, having been fully justified, as shown elsewhere.

No. XV.—This area advanced southeastward from Saskatchewan during the 27th, reaching Dakota the morning of the 28th. Thence, by a nearly northeast course, it passed during the 29th through the Upper Lake region, and on the 30th down the valley of the St. Lawrence. Its passage through the Lake region was marked by brisk winds, which justified, except at scattered stations, the signals displayed during 29th and part of the 30th; maximum velocities: Grand Haven, E. 28; Rochester, W. 32; Milwaukee, NW. 36; and Sandusky, NW. 42. On the Atlantic coast Cautionary Signals were displayed during the 29th at all stations except Jacksonville. These signals were lowered during the 30th on the South Atlantic coast, but were continued on the New England and Middle Atlantic coasts until the morning of May 1st. During the 29th violent southerly gales, with heavy rain-squalls, prevailed along the entire Atlantic coast, followed, in connection with advancing high area No. IX, by heavy westerly gales from Maine to Delaware; maximum velocities: Boston, SW. 37; Eastport, S. 39; Barnegat, S. 43; Kittyhawk, S. 46; Delaware Breakwater, S. 52; Wood's Holl, S. 56. This storm was generally reported to have been one of the severest experienced for years along the New England and Middle Atlantic coasts.

INTERNATIONAL METEOROLOGY.

Two International Charts, Nos. IV and VI, accompany the present REVIEW. They are for the months of *September*, 1877, and *March*, 1878. The charts of mean pressure, &c., for *September*, 1878, have been delayed to permit the compilation of chart for *September*, 1877, which completes the series for the autumn months of that year.

No. IV indicates the probable course of six of the principal storm-areas (No. I, II, IV, VI, IX and XI) occurring over the North Atlantic ocean during the month of *March*, 1880. This month was generally characterized by a rapid succession of high and low pressure areas and consequent stormy weather over the United States, Canada and that portion of the North Atlantic ocean to the north of a line running from the Bermudas to 50° N. 25° W., while over northwestern Europe high pressures and, in general, clear, dry weather were prevalent, except during the regime of low areas Nos. I, III and XI. Area No. I was, on the 1st, 2nd and 3rd, central to the north of the British Isles and North Sea, whilst the trough of low pressure extended far to the westward over the Atlantic; severe westerly gales prevailed from the English channel to 40° W., and from this meridian to the American coast, cold northwesterly winds, accompanied by occasional violent snow and hail-squalls, in advance of an area of high pressure (No. I, March WEATHER REVIEW) central over the United States. On the 3rd the highest pressure of the month (about 30.47 in., or 774.0mm.) was recorded at the Bermudas, and from the 4th to the 7th this high pressure moved slowly eastward to the region of the Azores. During these days, namely, from the 4th to the 7th, two areas of low pressure (the last of which is shown on chart No. IV as area No. II) left the American coast and, passing eastward over the Banks of Newfoundland, curved towards the northeast, about 50° W.; hard to violent winds, from S. to W., accompanied by severe rain-squalls, were experienced from 40° to 50° N. and from 30° to 50° W. During the 7th the pressure rose rapidly over western Europe, and on the morning of the 8th an area of quite high pressure covered the region included between 15° W. and 25° E. and 35° to 60° N. From the latter date to the 29th the pressure remained high over the greater part of this region, and apparently formed a barrier to the passage eastward of low pressure areas from the Atlantic. On the 9th only moderate winds were reported over the Atlantic, except that S. S. *Amerika*, in 48° 29′ N., 31° 10′ W., had an ENE. wind, force 8, with barometer down to 29.52, or 749.8. This appears to have been due to a small area which passed northward on the 10th, followed by NW. gales about 50° N. 30° W. Area No. IV. (No. V, March REVIEW) passed off the American coast during the morning of the 9th, and on the 10th passed eastward to the north of the Bermudas, where the wind increased to WSW., force 6, with threatening weather. Brigantine *George*, (10th,) in 32° 25′ N., 68° 35′ W., had a WSW. moderate gale, with low barometer, showers and rough sea. High pressures (area No. IV, March REVIEW) and cold weather prevailed in the vicinity of Newfoundland. On the 11th and 12th low area No. IV moved rapidly northeastward; and severe gales from SE. to NW. have been reported in 41° N. 60° W., 42° N. 53° W., 43° N. 47° W., 47° N. 40° W., and continued southerly gales thence eastward. S. S. *Amerika* (11th, in 45° N. 43° W.) reported barometer, at 7:35 a. m., Washington time, 29.30, or 744.2, wind SW., force 11, very heavy sea; "had a heavy gale from SE. to NNW. and back to W." Bark *Silver Cloud*, from New Brunswick to Great Britain, on the 11th had a severe SE. gale, with terrific squalls, veering, at 5 p. m., to SSE., and on the 12th severe gale from NNW.—vessel abandoned on the 12th in 45° N. 42° W. After the morning of the 12th, the progressive motion of this area appears to have lessened decidedly, and the area to have curved toward the east. S. S. *Hibernian* reports 12th, in about 50° 39′ N. 33° 17′ W., lowest barometer 29.25, or 743.0, strong gale from SE. by S., with heavy rain; 13th, 52° 17′ N. 27° 14′ W., lowest barometer 29.26